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PTO/SB/05 (4/98)
Approved for use through 09/30/2000. OMB 0651-0032
Patent and Trademark Office. U.S. DEPARTMENT OF COMMERCE

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	
First Inventor or Application Identifier	Wayne L. Pratt
Title	Double Diap. Prec. Throttling Valve
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

jc678 U.S. PTO 09/556208 04/24/00

1. [X] * Fee Transmittal Form (e.g., PTO/SB/17)
   (Submit an original and a duplicate for fee processing)
2. [X] Specification [Total Pages 6]
   (preferred arrangement set forth below)
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings (if filed)
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
3. [X] Drawing(s) (35 U.S.C. 113) [Total Sheets 1]
4. Oath or Declaration [Total Pages 3]
   a. [X] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 C.F.R. § 1.63(d))
   (for continuation/divisional with Box 16 completed)
      i. [ ] DELETION OF INVENTOR(S)
      Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

5. [ ] Microfiche Computer Program (Appendix)
6. Nucleotide and/or Amino Acid Sequence Submission
   (if applicable, all necessary)
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. [ ] Assignment Papers (cover sheet & document(s))
8. [ ] 37 C.F.R.§3.73(b) Statement (when there is an assignee) [ ] Power of Attorney
9. [ ] English Translation Document (if applicable)
10. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
11. [ ] Preliminary Amendment
12. [X] Return Receipt Postcard (MPEP 503)
    (Should be specifically itemized)
13. [ ] * Small Entity Statement(s) (PTO/SB/09-12) [ ] Statement filed in prior application, Status still proper and desired
14. [ ] Certified Copy of Priority Document(s)
    (if foreign priority is claimed)
15. [ ] Other: ....

16. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in a preliminary amendment:*

[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: ______/______

Prior application information: Examiner ______________ *Group / Art Unit:* ______________

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

[ ] *Customer Number or Bar Code Label* (Insert Customer No. or Attach bar code label here) *or* [XX] *Correspondence address below*

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Name (Print/Type)	Wayne L. Pratt	Registration No. (Attorney/Agent)	
Signature	Wayne L. Pratt	Date	4-24-00

09556208.042400

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STATEMENT CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) & 1.27(b))--INDEPENDENT INVENTOR	Docket Number (Optional)

Applicant, Patentee, or Identifier: Wayne L. Pratt

Application or Patent No.: __________

Filed or Issued: __________

Title: Double Diaphragm Precision Throttling Valve

As a below named inventor, I hereby state that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office described in:

- [x] the specification filed herewith with title as listed above.
- [ ] the application identified above.
- [ ] the patent identified above.

I have not assigned, granted, conveyed, or licensed, and am under no obligation under contract or law to assign, grant, convey, or license, any rights in the invention to any person who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- [x] No such person, concern, or organization exists.
- [ ] Each such person, concern, or organization is listed below.

Separate statements are required from each named person, concern, or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

Wayne L. Pratt	William M. Kolarik	N / A
NAME OF INVENTOR	NAME OF INVENTOR	NAME OF INVENTOR
[signature]	[signature]	
Signature of inventor	Signature of inventor	Signature of inventor
4-24-'00	4-24-00	
Date	Date	Date

Title: A free draining double diaphragm stepper motor actuated plastic throttling valve suitable for both ultra pure and hazardous fluids.

References cited: U.S. PATENT DOCUMENTS

5,002,086	Linder, et al.
5,094,426	Zajac
5,346,172	Gonsior
5,706,855	Heinger
4,010,769	De Lorenzo, et al.
5,419,530	Kumar
5,217,043	Novakovi

FIELD OF INVENTION

The present invention relates to fluid control devices and in particular to those applications where materials of construction must be compatible with the process fluids and where it is a requirement that minimal volumes of fluids are captured within the valve. Often times the only suitable material meeting these requirements will be PTFE or other Teflon types. Furthermore, these applications often require that no cracks or crevices are present to permanently capture fluids or particulate carried by the fluid. Another requirement where slurries are being controlled is that the fluid should not be subjected to high rates of shear. Lastly, these fluids are often highly toxic and a double containment is necessary for any thin walled barrier in contact with the fluid.

BACKGROUND OF INVENTION

Many forms of throttling valve are found within the field. Viraraghavan describes a valve in patent '530(cited in the references) that that is typical of valves that may, at first, may be deemed to be satisfactory for these applications. However, as is typical in many valve designs the stem must be sealed with o-rings. This introduces both small cracks and crevasses, as well as another material(the o-ring) that may not be compatible with the process fluid. These problems can be solved with diaphragm valves. Linder, in patent '086(sited in the references) describes one such approach. Here a metallic actuation shaft is buried in the flexible diaphragm such that it is susceptible to corrosion from ionic migration from some process fluids. Secondly, this valve contains a large number of parts of metallic content as well as a comparative large volume of fluid should the primary diaphragm fail. Generally valve designs described in the art attack one or two of the problems described, but none approach the whole problem of safely handling highly toxic or corrosive fluids while providing a smooth continuos laminar flow in a free draining, low captive volume device.

The throttling mechanisms described in the art contain sharp corners and short flow paths to control the flow. Many fluids are both hazardous and suffer detrimental effects to sheer effects when flowing around such obstructions. The slurries used in the semiconductor industry are known for their sensitivity to shear. It is generally known in fluid mechanics, that laminar flow is achieved for Reynolds numbers of less then 2000. Where the Reynolds number is computed as follows:

$$Re = Dv\rho/\mu_e$$

Where D is the height of the flow channel, v the fluid velocity, ρ the density, and μ_e the fluid viscosity. Furthermore, the pressure drop, ΔP, along the channel is expressed differently for laminar flow that for turbulent flow which occurs and higher Reynolds numbers.

For Laminar flow: $\Delta P = K(\mu Lv/D^2)$
For turbulent flow: $\Delta P = K'(L/D)(v^2)$

Where K and K' are constants of proportionality that depend on the engineering units selected. It can be clearly seen that the pressure drop, hence, the throttling effect on the flow stream is a *linear* relationship to the fluid velocity for laminar flow and a *velocity squared* relationship for the turbulent flow case. Obviously the ideal case is a linear relationship of pressure loss to flow velocity across the throttling range. A less desirable situation is the square law response where the response of the valve continuously varies over the throttling range. Any configuration that results in the flow response being linear over a portion of the range and transitioning to square law at some point will have a detrimental effect on the ability of the controller to smoothly regulate the flow. In additions since both relationships contain the length factor L in the numerator it is desired to have some length to the throttling path.

In order to provide a throttling effect it is necessary to control the opening of the fluid channel. Many means are described in the art. These are typically motors, solenoids, compressed air, or manual adjustment devices. The applications envisioned herein all contain a flow meter to measure the flow and advanced electronics to position the valve to achieved the desired mass or volumetric flow rate. Thus, the position of the valve is not so much of interest as is the results measured by a suitable flow meter. However, in such feed back arrangement the valve undergoes continuous repositioning, and therefore must have a reliable drive mechanism with little or no backlash. Furthermore, as the fluids may be under pressures up to 100 psi the drive mechanism must operate with a wide range of axial loads. Generally drive mechanisms described in the references were judged as incapable of continuous repositioning, or would exhibit excessive backlash detrimental to smooth fluid control. A second feature found to be overlooked in the current art is the ability to remove the drive mechanism and inspect it without the risk of opening the fluid path.

Reviewing the references cited we find that none of them attempt to solve the full range of the problems posed herein.

SUMMARY OF INVENTION

A free draining fluid path with minimal internal volume and no cracks or crevasses and free of sharp corners is achieved by this invention. Furthermore, the invention provides a smooth throttling path of some length and double containment for the process fluid retained by the thin walled diaphragm. The valve body is machined from a solid block of homogenous material. In this embodiment it is Teflon(PTFE), but could be anything compatible with the anticipated process fluid. An inlet directs the flow stream to an island within the fluid cavity of the valve. A moveable diaphragm and integral throttling surface is a female match to this island. Thus, when the diaphragm is extended and the throttling surface mates with the island the flow stream is shut off from passing through the valve. As the diaphragm is retracted from the closed position the fluid will flow through the gap between the throttling surface mating form and the island into the valve cavity. From the cavity it passes unimpeded to the outlet of the valve body.

The diaphragm is a thin walled flexible membrane sufficiently flexible to be capable of seating down on the island to close off the flow path and progressively retracted from the island to offer decreasing resistance to fluid flow. The diaphragm is designed to be flexible but sufficiently strong enough to with stand fluid pressures up to 60 psi with adequate safety margin. In order to provide safety a secondary diaphragm of similar design is captured immediately above the primary diaphragm. A threaded stem on the upper side of the primary diaphragm provides a means to capture the two diaphragms with a threaded drive shaft. Both diaphragms are machine from Teflon(PTFE) or other suitable material to be compatible with the process fluid. This threaded drive shaft is made from Hastelloy C22. Hastelloy has been chosen for its corrosion resistance. This is an added precaution due to the fact that many corrosives, such as

Hydrochloric Acid will produce ions that can leach through Teflon over time. The threaded drive shaft has internal threads for locking the diaphragms and external threads for interfacing with the rotor.

Both diaphragms have squared off shoulders at their periphery. These squared off sections are sized such that when the drive housing is tightened onto the valve body the fluid is sealed within the fluid cavity. A weep hole is provided from the out side of the valve body to the space between the two diaphragms. This, along with a radial canal just outside the diaphragm seals, provide a means of detecting a leak in the primary diaphragm.

The rotor is fixed in position by thrust bearings captured between the rotor and the drive housing. The rotor is free to turn under all vertical loads, and will position the drive shaft, and diaphragms down onto the flow island to close the flow path, or re positioning the diaphragms in the upward direction, to progressively open the path to fluid flow. The lower bearing assembly is the smaller of the two. Its only function is to produce a small vertical pre load on the rotor. Since all positive fluid pressures will be in the same direction the pre load is only set so that at zero, or slightly negative fluid pressures, the rotor will still have some vertical loading. The vertical load on the rotor will increase directly with fluid pressure. At 60 psi this load will be 105 lbs. The large bearing assembly is sized to take this loading with a conservative margin. Thus the rotor is free to turn under all anticipated loads. Furthermore, the loading will be in the same vertical direction under all anticipated circumstances minimizing backlash.

The top of the rotor has a slot cut in it to receive a plastic insert of moderate hardness. This insert also contains a slot that matches a tab machined on the drive shaft of the motor. There is a slight interference in the fit of the motor tab and the plastic insert. The reason for this is that the motor in modulating the flow under the command of a remote electronic system will be undergoing constant reversals. This interference assures that the slot and tab will not have any backlash or create excessive noise or wear during operation.

The motor is affixed to the top of the drive housing and connects directly to the rotor as described above. The motor in this embodiment is a standard frame 17 stepper motor, but may be any suitable drive device, such as a DC motor, AC motor, servo motor. It may be desirable for the electronic system to be able to receive feedback on the position of the diaphragms. This is accomplished by attaching a switch of optical or mechanical means to a threaded drive shaft attached with a coupling to the rear shaft of the motor. This threaded shaft will drive a cam in the vertical directions. The switch and cam are arranged so that when the valve is closed to fluid the switch will also be closed. This feedback signal can be used by the controlling electronics, if necessary to sense the closed position. Alternatively, a potentiometer or other encoder may be so attached to provide continuous feedback to the controller.

The valve assembly described above is then housed in an outer housing of suitable material for the environment of the anticipated application.

DESCRIPTION OF DRAWINGS

There are five drawings referred to herein. **Figure 1** is a cross section through the center of the valve assembly in the plane of the flow path. **Figure 2** is a cross section through the center of the valve assembly perpendicular to the plane of the flow path. The switch/encode that maybe optionally installed has been left out of these illustrations. **Figure 3** is a cross section, in either plane described in **Figures 1 and 2** of the drive housing and internal components. **Figure 4** is a cross section of the double diaphragm and drive shaft. Finally, **Figure 5** is a cross section of the motor and optional encoder. In this case the encoder is a switch providing a contact closure when the diaphragms are in the closed position.

DETAILS OF INVENTION

The inlet **19a** provides a threaded coupling to the users process fittings and communicates the fluid though to the integral diaphragm and throttling surface **2**. From this point the fluid flow is controlled into the inner valve cavity where it is then free to flow to the exit port **19b**. The valve body **1** is made from a solid block of Teflon(PTFE, in this case). The primary diaphragm **2** and back up diaphragm **3** are pinched and held in place by the drive housing **7**. The drive housing is firmly attached to the valve body as described below. Sealing is accomplished without the need for o-rings by slightly over sizing the shoulders of the two diaphragms **24**. The primary diaphragm has the throttling surface machined onto the lower side and a threaded stem **22** machined onto the upper side. This throttling surface is the female form of the discharge island. The threaded stem is used to connect to the drive shaft **8** as well as pinch the backup diaphragm **3** onto the primary diaphragm **2**. The drive shaft **8** is made from Hastelloy C22 well know for it corrosion resistance. Although the drive shaft is isolated from the process fluid by both Teflon(PTFE) diaphragms it can be corrosively attacked by ions leaching through the Teflon.

The drive housing **7** is held to the body **1** by through bolds **20**. In order to carry the compression load of the bolts two metallic holding bars **4** are provided. All of these metallic components are isolated from the fluid by considerable distances of Teflon. The drive train consists of a small thrust bearing **5** and wavy spring **25** that provide a vertical pre load on the rotor **9**. The rotor **9** drives the threaded drive shaft to position the diaphragms and thus controls the gap in the throttling surfaces. The large diameter thrust bearings 6 take the vertical load imposed by the fluid pressure onto the diaphragms and the connected drive assembly. This loading will be a maximum of 105 pounds for 60 psi of fluid pressure. A stepper motor **11** is fitted to the top of the drive housing and couple directly to the rotor **9** via slot in the rotor **26** and matching tab machined onto the motor drive shaft.

The motor mounts on top of the drive housing **7** mating with the housing lid and using the 4 bolt pattern of the motor mount to affix the motor and lid to the housing. The motor **11** and housing **7** are then secured to the valve body **1** by the 4 through bolts **20** and holding bars **4**. Two threaded spacers **12a** and **12b** may be substituted for the motor mounting bolts for mounting the optional encoder/position switch **18** and actuating mechanism **16**,**17**. In this case a coupling **14** is used to attach threaded encoder shaft **15**. This shaft drives the threaded bushing **16** in and attached cam **17** in the vertical direction corresponding with the position of the diaphragms as positioned by the motor and direct connection to the rotor at the other end of the motor drive shaft. The position may be adjusted so that when the diaphragms and integral throttling surface are closed down on the discharge island the switch will be closed. Alternately, the threaded shaft **15**, bushing **16**, and cam **17** maybe replaced with a potentiometer, or other suitable encoder.

CLAIMS

What is claimed is:

1 A free draining plastic throttling valve utilizing an integral diaphragm throttling surface, backed up with a secondary diaphragm for regulating the flow of various process fluids comprising.

(a) a plastic valve body having and inlet and outlet. The inlet extending into the housing and up to a throttling area mating with the primary diaphragm throttling surface.

(b) an outlet channel passing from the captive volume downstream of the throttling region and within the valve to the outlet port, arranged to free drain said captive volume.

(c) minimal captive volume to port volume ratio.

(d) a throttling surface consisting of a small and adjustable gap along a constant distance of considerable length creating a linear pressure drop with increasing flow velocity.

(e) a fluid passage way and internal cavity free of sharp corners, cracks, or crevasses.

(f) a valve assembly of wetted components of constant material type.

(g) a valve assembly of plastic where the required metallic components are isolated at safe distances of barrier plastic to minimize ionic migration from the process fluid to said metallic components.

2. A free draining plastic throttling valve of double diaphragm construction for the safe containment of hazardous and toxic process fluids comprising.

(a) the features enumerated in **claim1**.

(b) a weep hole and passage way to detect a break or leak of the primary diaphragm without the need for disassembling the valve.

3. An integral throttling surface and primary diaphragm comprising.

(a) tapered sides and a flat fluid discharge matching the contour of the body discharge area whose gap is controlled by the positioning of the diaphragm causing the fluid pressure drop to be a linear relationship to the flow through the gap.

(b) an integral threaded stem for capturing the backup diaphragm on the non wetted side of the primary diaphragm.

(c) an integral threaded stem for capturing the backup diaphragm on the non wetted side of the primary diaphragm directly to a threaded drive shaft for positioning said diaphragms for the regulation of the fluid flow rate.

(d) an integral rectangular cross section rim machined at the periphery of the diaphragms for the purpose of providing a fluid seal without the need for o-rings or new wetted materials.

(e) a construction of tandem diaphragms such that one backs up the other and both maybe positioned synchronously by an attached threaded drive shart

4. a construction of tandem diaphragms that include a weep hole bored into the space in between the two diaphragms providing for the detection of a leak in the primary diaphragm.

5. A drive shaft providing direct coupling from a rotor to the positioning of the diaphragms comprising.

(a) corrosion resistant material.

(b) flat sections machined on either side to prevent the unwanted rotation of the drive shaft relative to the captured diaphragms.

(c) a construction of tandem diaphragms and metallic drive shaft for positioning said diaphragms relative to a mating surface.

6. A screw drive mechanism for translating rotational to linear motion using a large diameter rotor for carrying comparatively large axial loads comprising

(a) self lubricating materials minimizing wear and galling of the threaded drive shaft and rotor interface.

(b) a gap in the threads to provide a capture space for lubricant when lubrication is needed to protect the threads beyond the natural self lubricating characteristics of the material.

(c) a set of thrust bearings maintaining the rotor in a state of free rotation isolated from the vertical load carried by the bearings.

(d) a wavy spring providing a vertical pre load on the rotor such that there will be a constant direction load carried in the threads of the rotor for all anticipated process fluid pressures.

7. A general compact construction such that the valve drive mechanism maybe disassembled and inspected with out the need to remove or depressurize the process fluid.

8. A construction comprising a contoured discharge port on the valve body within the fluid cavity matching the contour of the diaphragm and integral throttling surface. The matching contours are substantially flat so that if the motor should over run in the close direction the throttling surfaces will bottom out and not deform or otherwise get stuck in the closed position.

ABSTRACT

A throttling valve assembly actuated by a stepper motor having a double diaphragm seal and integral throttling surface. The throttling surface interfaces to a mating orifice and port arrangement to provide a smooth control regime for various process fluids. Because of the unique design of the flow paths the fluids will remain in a laminar flow state throughout the throttling range, thus providing smooth and continuous response to the control input. The valve opening to the fluid controlled by a stepper motor through a direct drive mechanism. The embodiment shown here employees all PTFE construction for the wetting parts, but any material could be used that would be compatible with the process fluid. Additional features are minimal capture of the process fluid, free draining, and no metallic parts in close communication with the process fluid.

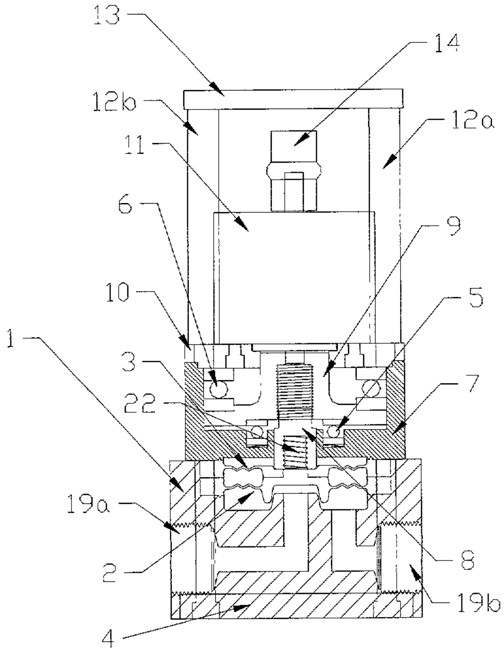

Figure 1

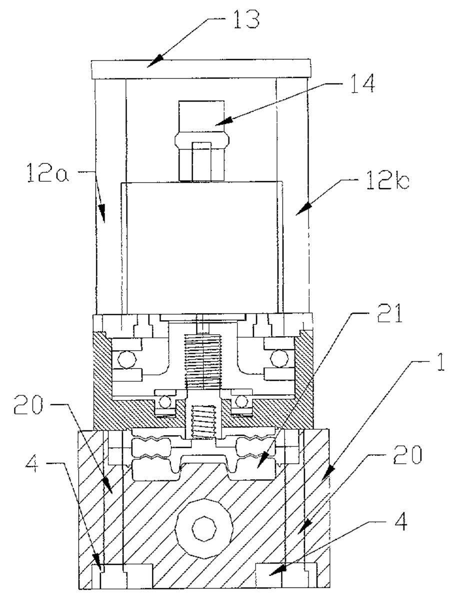

Figure 2

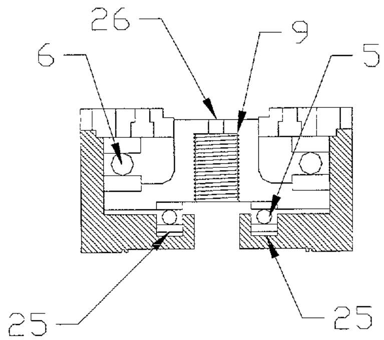

Figure 3

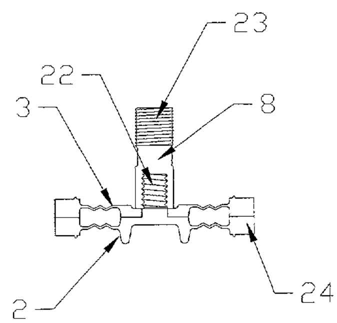

Figure 4

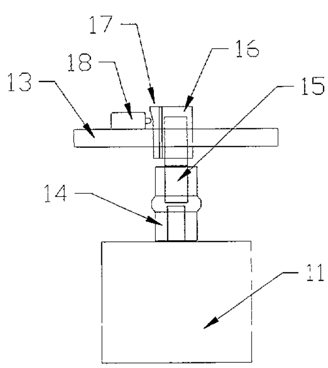

Figure 5

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☒ Declaration Submitted with Initial Filing **OR** ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	
First Named Inventor	Wayne L. Pratt
COMPLETE IF KNOWN	
Application Number	/
Filing Date	
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Double Diaphragm Precision Throttling Valve

(Title of the Invention)

the specification of which

☒ is attached hereto

OR

☐ was filed on (MM/DD/YYYY) [ ] as United States Application Number or PCT International Application Number [ ] and was amended on (MM/DD/YYYY) [ ] (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto·

I hereby claim the benefit under 35 U.S C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	
		☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

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DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number *(if applicable)*

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☐ Customer Number [ ] → *Place Customer Number Bar Code Label here*
OR
☐ Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: ☐ Customer Number or Bar Code Label [ ] *OR* ☒ Correspondence address below

Name	Wayne L. Pratt				
Address	16028 N. 63rd Street				
Address					
City	Scottsdale	State	AZ	ZIP	85254
Country	USA	Telephone	480-483-7723	Fax	480-483-0290

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
Wayne L.	Pratt

Inventor's Signature	Wayne L. Pratt					Date	4-24-00
Residence: City	Scottsdale	State	AZ	Country	USA	Citizenship	USA
Post Office Address	16028 N. 63rd Street						
Post Office Address							
City	Scottsdale	State	AZ	ZIP	85254	Country	USA

☒ Additional inventors are being named on the 1 supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto

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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

DECLARATION

ADDITIONAL INVENTOR(S)
Supplemental Sheet
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Name of Additional Joint Inventor, if any: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
William Michael	Kolarik

Inventor's Signature	WmKolarik					Date	4-24-00
Residence: City	Phoenix	State	AZ	Country	USA	Citizenship	USA
Post Office Address	918 W. Wagon Wheel Drive						
Post Office Address							
City	Phoenix	State	AZ	ZIP	85021	Country	USA

Name of Additional Joint Inventor, if any: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
Not Applicable	

Inventor's Signature						Date	
Residence: City		State		Country		Citizenship	
Post Office Address							
Post Office Address							
City		State		ZIP		Country	

Name of Additional Joint Inventor, if any: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname

Inventor's Signature						Date	
Residence: City		State		Country		Citizenship	
Post Office Address							
Post Office Address							
City		State		ZIP		Country	

Burden Hour Statement: This form is estimated to take 0 4 hours to complete. Time will vary depending upon the needs of the individual case Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231 DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO· Assistant Commissioner for Patents, Washington, DC 20231.